INTERLAB SERIES

TYPE MP-25

PULSE GENERATOR

OPERATING AND SERVICE MANUAL

MP MASTER

MA23353

LYONS INSTRUMENTS

INSTRUCTION MANUAL

INTERLAB SERIES

TYPE MP-25

PULSE GENERATOR

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LYONS INSTRUMENTS LIMITED

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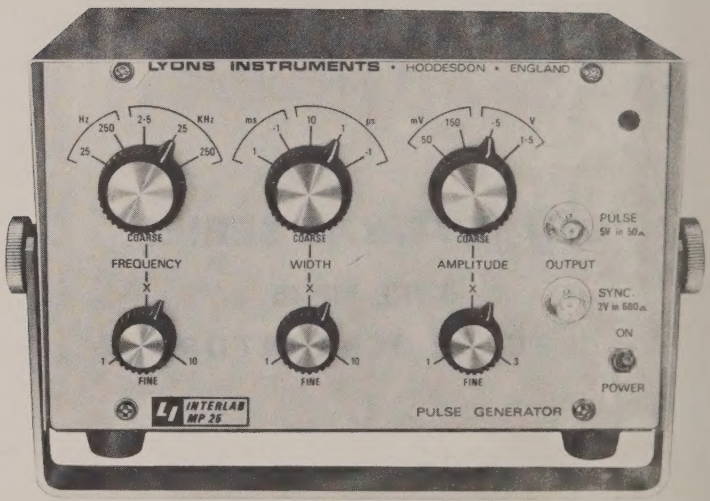

LYONS INSTRUMENTS • HODDESDON • ENGLAND
Hz
250
2·5
25
KHz
25
250
COARSE
FREQUENCY
X
1
10
FINE
ms
·1
10
1
µs
1
·1
COARSE
WIDTH
X
1
10
FINE
mV
150
·5
V
50
1·5
COARSE
AMPLITUDE
X
1
3
FINE
PULSE
5V in 50Ω
OUTPUT
SYNC.
2V in 600Ω
ON
POWER
INTERLAB
MP 25
PULSE GENERATOR

INTRODUCTION

The Lyons Instruments type MP25 Pulse Generator is an inexpensive pulse source with wide ranges of pulse frequency, width and amplitude. It is an ideal instrument for use in development or educational laboratories where simplicity of operation and low cost are important factors.

The frequency range and amplitude of the output pulse have been selected to cover most general purpose requirements and its robust construction makes it suitable for use in routine production testing.

This handbook provides all the information required to enable the user to obtain optimum performance and service from the instrument. If further information is required, please contact the LI Engineering Department, who will be pleased to assist.

The MP25 is one of Lyons Instruments' "INTERLAB" (t.m.) series of high performance, low cost, electronic instruments for laboratory, test and education. Other models currently available include the D10 Distortion Meter, FM25 Frequency Meter and SQ10 Sine/Square Oscillator.

SECTION 1

SPECIFICATIONS

Frequency Range	25 Hz - 2·5 MHz in five decade ranges. Fine control with overlap.
Jitter	Less than 0·1% of period.
Width	100 ns - 10 ms in five decade ranges. Fine control with overlap.
Jitter	Less than 0·1% of width +1 ns.
Main Output	
Amplitude	5 volts positive from ground, when terminated in 50Ω. 10V may be obtained into an open circuit with reduced specifications for rise/fall times and aberrations.
Attenuation	5V to 50 mV in four switched positions: 5V : 1·5V : 0·5V : 0·15V. Fine control of greater than 3:1.
Rise Time	Less than 10 ns.
Fall Time	Less than 10 ns.
Aberrations	Less than 5% p-p overshoot and ringing.
Duty Cycle	100%.
Protection	Up to ±12 volts may be applied to output socket.
Sync. Output	+2V minimum, open circuit. +0·5V into 100Ω, 50 ns ±15 ns width.
Protection	Up to ±12 volts may be applied to sync output socket.
Temperature	Operating range: 0 to 45°C. Storage: -20 to +70°C.
Power Input	200/220/240V; 50/60 Hz.
Size	8" wide x 5" high x 6" deep (205 x 130 x 150 mm).

SECTION 2

OPERATION

CAUTION

The main and sync pulse outputs are both short and open circuit proof, but can be damaged if d.c. voltages in excess of ±12V are applied.

2.1. General

The MP25 Pulse Generator is extremely simple to use since there are only three variables to adjust - the frequency (pulse repetition rate), width, and the amplitude of the output pulse.

2.2. Mains Supply

The instrument is normally supplied connected for operation from a 240V nominal 50-60 Hz mains supply. Alternative transformer tappings for operation on 200V or 220V supplies are provided and are accessible by removal of the instrument cover (see sections 3.5. and 4.2.1.)

2.3. Frequency and Width Controls

Both frequency and width controls comprise a coarse range switch with decade steps and a fine control to give the setting required within the decade. First select the frequency required by switching to the appropriate range and then adjusting the fine frequency knob to give the

required pulse repetition rate. Pulse width should then be set, ensuring that it is compatible, i.e. that width is less than the period at the selected frequency.

The design of the width monostable allows the instrument to be operated up to 100% duty cycle (pulse width equal to period) without the necessity for a complement mode, but it should be noted that beyond the 100% point the output will become a d.c. level equal to the pulse amplitude setting, and for correct operation the width setting must be reduced until the desired pulse appears.

The width and frequency fine controls each have a range of approximately 20:1, giving ample range overlap.

2.4. Amplitude Controls

The coarse (switched) output attenuator is calibrated in volts into 50 ohms, the fine control having a range in excess of 3:1 to ensure overlap between the coarse control steps. The output should always be terminated in 50 ohms if the specified rise and fall times are to be obtained.

An open circuit output of +10V can be obtained, when the rise and fall times will be slower than specified.

2.5. Sync Output

The sync. output will give a well defined pulse approximately 50 ns wide and +0·25V amplitude when terminated in 50 ohms. Higher amplitude pulses (approximately +2V) will be obtained when working into an open circuit, but pulse shape and width specifications will be degraded.

SECTION 3

CIRCUIT DESCRIPTION

3.1. Frequency Generator

The frequency generator or clock consists of Q1, Q2, Q3 with Q1, Q2 connected as a schmitt trigger circuit and Q3 used as a capacitor charging current source. The fine frequency control RV4 provides a current which discharges the timing capacitor negatively until the base of Q2 becomes negative to the base of Q1. At this point Q1 switches on, allowing Q3 to conduct and so charge the timing capacitor until Q1 and Q3 are switched off again. Thus the amplitude of the timing waveform is determined by the hysteresis level of the schmitt trigger circuit Q1, Q2 which in turn is set by the emitter current of Q1.

When Q3 conducts Q4 is also switched on and C5 in the emitter of Q4 is discharged into the collector circuit, providing a positive going spike which is a.c. coupled to the base of Q7 where it is differentiated to provide a fast negative going trigger to the width generator circuits.

3.2. Sync Output

The spike from Q4 is also applied to the input base of emitter coupled pair Q5, Q6, the collector of Q6 providing the sync. output pulse.

3.3. Width Generator

The width ramp generator consists of transistors Q8, Q9, Q10. In the quiescent state Q8 is on and the current flowing into the base of Q9 via the zener diode D5 is less than the current flowing out via R25, the difference being taken via diode D6 to clamp the base circuit at about -0·7V, thus holding Q9 off. In this state the timing capacitor will be charged positively by the timing current from the fine width control RV2 until it is clamped to approx. +6V by D8.

On receipt of a negative trigger pulse Q8 will be turned off and its current diverted into the base circuit of Q9, which will now exceed that taken out via R25, thus turning Q9 on and holding Q8 off. Q9 turning on will discharge the timing capacitor negatively until the voltage on it is greater than one V_{be} negative to the potential on the base of Q10, when Q10 will turn on. This transistor then takes current out of the base circuit of Q9 which will once again be clamped to -0·7V, turning Q9 off and turning Q8 on, and thus returning the circuit to its quiescent state. The timing capacitor will charge at a rate set by RV2 until clamped once again by D8.

3.4. Output Amplifier

Q11, Q12 form a schmitt trigger which is switched by the negative excursion of the timing capacitor waveform and thus forms the width waveform. This is passed via emitter follower Q13 to an emitter coupled amplifier Q14, Q15

whose collector excursion can be varied from 10V to 3V by varying its emitter current with the variable current source Q16. RV3 in the base circuit of Q16 thus acts as a fine amplitude control over the output range 3-10V. The resulting waveform on the collector of Q14 is passed via emitter follower Q17, source impedance R43, and coarse attenuator switch S3 and associated resistors, to the output socket.

Diode D11 in series with the output is provided to prevent reverse voltage applied to the output socket exceeding the breakdown potential of the output follower base-emitter junction.

3.5. Power Supplies

The power supply circuits are mounted on a separate printed circuit board fitted to the case baseplate. Two separate supplies are generated at +24V and -12V, but the circuits used are essentially similar with only minor component changes to provide the two output levels.

A common transformer T1 is used to supply two bridge rectifiers D1-4 and D5-8 for the positive and negative supplies respectively. Considering the positive supply only, Q1 and Q3 provide the control circuit with D9 supplying the required reference level and RV1 the necessary control for setting output level. Q2 is the series regulator providing the full output load stabilisation.

T1 is equipped with three primary tappings, for nominal 50-60 Hz supply levels of 200V, 220V, and 240V respectively.

SECTION 4

CALIBRATION & SERVICING

4.1. Calibration Procedure

There is only one internal adjustment potentiometer on the main board of the MP25, and this will require adjustment only in the event that a device has been changed in the output amplifier. In this case proceed as follows:

4.1.1. Power Supplies

The power supplies should be set to +24V ±10% and -12V ±10% respectively, using potentiometers RV1 and RV2 located on the power supply printed circuit board.

4.1.2. Output Amplifier

With the output pulse set to maximum amplitude and terminated in a good 50Ω coaxial load, the pulse should be displayed on an oscilloscope having a rise time of 7 ns or better. With the oscilloscope time base set to approx. 20 ns/cm, RV1 on the main board should be adjusted for the cleanest pulse top edge consistent with better than 10 ns rise and fall times.

If when this has been done the output pulse is slightly less than 5V in amplitude, it may be necessary to adjust slightly the +24V supply as in 4.1.1 above to obtain 5V output. The setting of RV1 on the main board should then be rechecked.

4.2. Servicing

The instrument front panel controls should be set as follows:

Frequency	Coarse range:	250 Hz - 2·5 kHz
	Fine Control:	Fully Clockwise
Width	Coarse range:	100 µs - 1 ms
	Fine control:	Fully clockwise
Amplitude	Coarse attenuator	1·5 - 5V
	Fine control:	Fully clockwise

The output should be terminated in a good 50Ω coaxial load, with an oscilloscope of at least 50 MHz bandwidth connected via a Tee-connector at the load.

An output pulse should now be observed on the oscilloscope, with a repetition rate of approximately 3 kHz, duty cycle of 30%, and a level of +5 volts. The rise and fall times should be less than 10 ns (to observe this the oscilloscope bandwidth must be at least 50 MHz).

In the event that the instrument fails to operate correctly the following procedure should enable the fault to be isolated to within one or two transistors and associated components.

4.2.1. Power Supplies

Remove the front panel by releasing the four fixing screws and pulling forward. The main printed circuit board is attached to the front panel and is easily accessible once this has been removed from the case. The power supply

voltages should be measured using an Avometer or similar instrument, and should read +24V ±10% and -12V ±10%.

If the supplies are found to be outside these limits, firstly check that the correct mains tapping (see section 2.2) is being used, and if necessary change this appropriately. If mains tapping is correct, the supplies should then be disconnected from the main board and rechecked. If they are still in error, the cover should be removed from the case. It is retained by eight screws on the back and base of the case. A careful visual inspection of the power supply board should be carried out for shorts caused by track bridging, wires trapped under screws, or damaged components. If this does not reveal the fault it can rapidly be localised by voltage measurements using the circuit diagram.

4.2.2. Main P.C. Board

If the supplies are operating correctly but no output or an incorrect output is obtained when the instrument is set to the conditions given in 4.2. above, the circuits should be checked systematically using an oscilloscope, preferably of 50 MHz bandwidth or greater, in conjunction with the circuit diagram and the circuit description given in Section 3.

Check that the clock is operating by connecting the oscilloscope probe to the pin from which the connection to frequency range switch S1 is made (junction of R6 and C4) when a 3 kHz sawtooth waveform should be observed. If this is satisfactory, determine that there is a sync output signal at the front

panel socket and then check for a negative going spike, 2V in amplitude and approximately 10 ns wide, on the base of Q8.

Note: The connection of the probe on the base of Q8 may present sufficient loading to prevent triggering of the width monostable, and it should therefore not be left on this point during further checks.

The next measurement should be made on the connection from R30 to the width range switch S2, where a ramp waveform of 3V amplitude should be observed. Move the probe to the collector of Q12 where a 2V pulse should be seen with a width similar to the width of the ramp waveform seen in the foregoing measurement. This pulse waveform should then be observed amplified to 10V peak to peak on the base and emitter of Q17 and thence to the output socket.

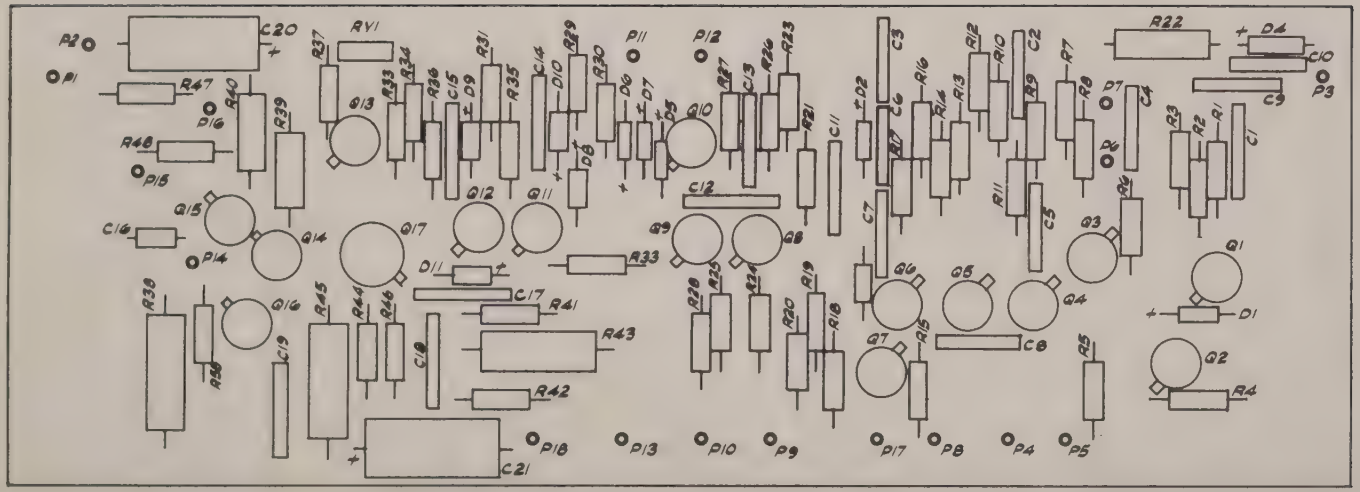
Following the above sequence should enable the fault to be isolated to a group of two or three transistors which can quickly be checked by replacement or further isolated by measurements made in conjunction with the circuit description and circuit diagram.

4.3. Warranty

Lyons Instruments Limited guarantees each instrument supplied by us to be free from defects in material and workmanship for a period of one year from date of delivery to the original purchaser. Repair during this time will be made free of charge if the instrument is returned to our works carriage paid.

If an instrument is believed to be defective, please notify our Service Department, giving the model and serial number of the instrument, as well as a brief description of the fault. Our Service Department will then, if necessary, authorise the return of the instrument under the terms of this guarantee and advise how shipment should be made.

No instrument should be returned to the factory without prior authorisation from Lyons Instruments Limited.



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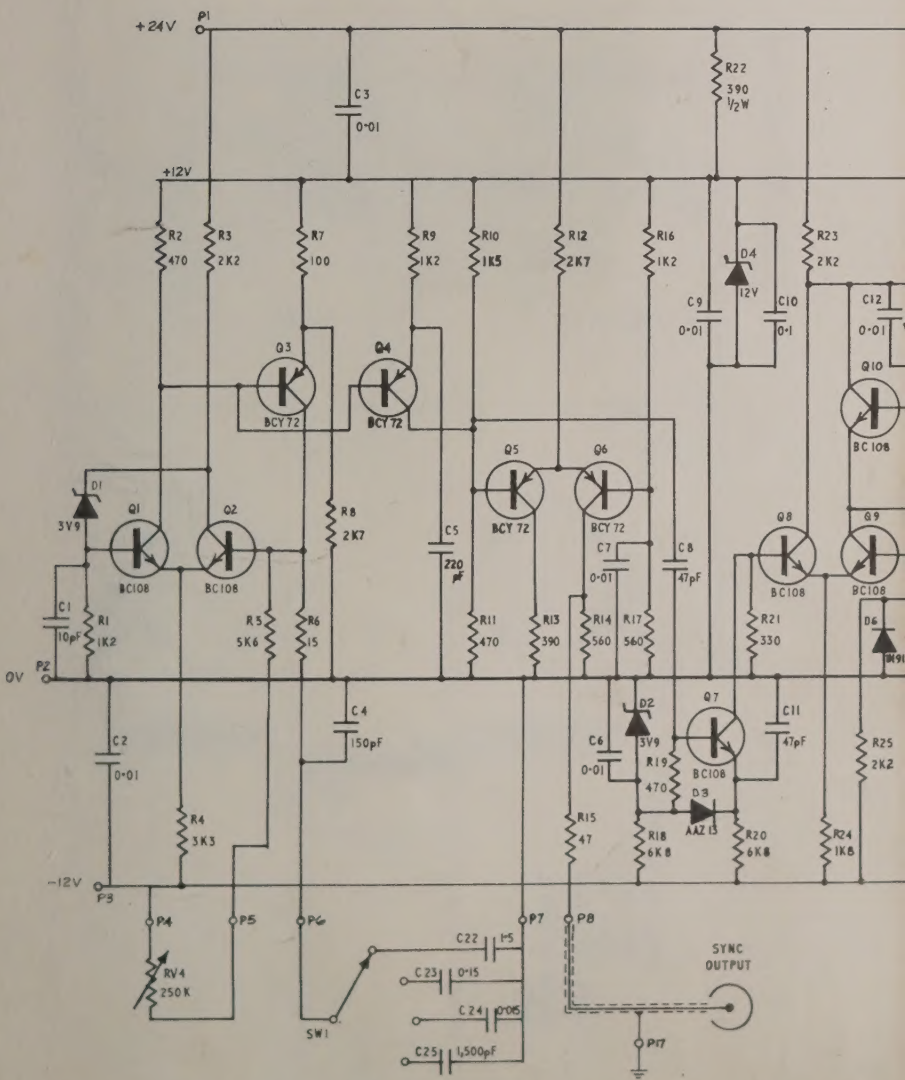
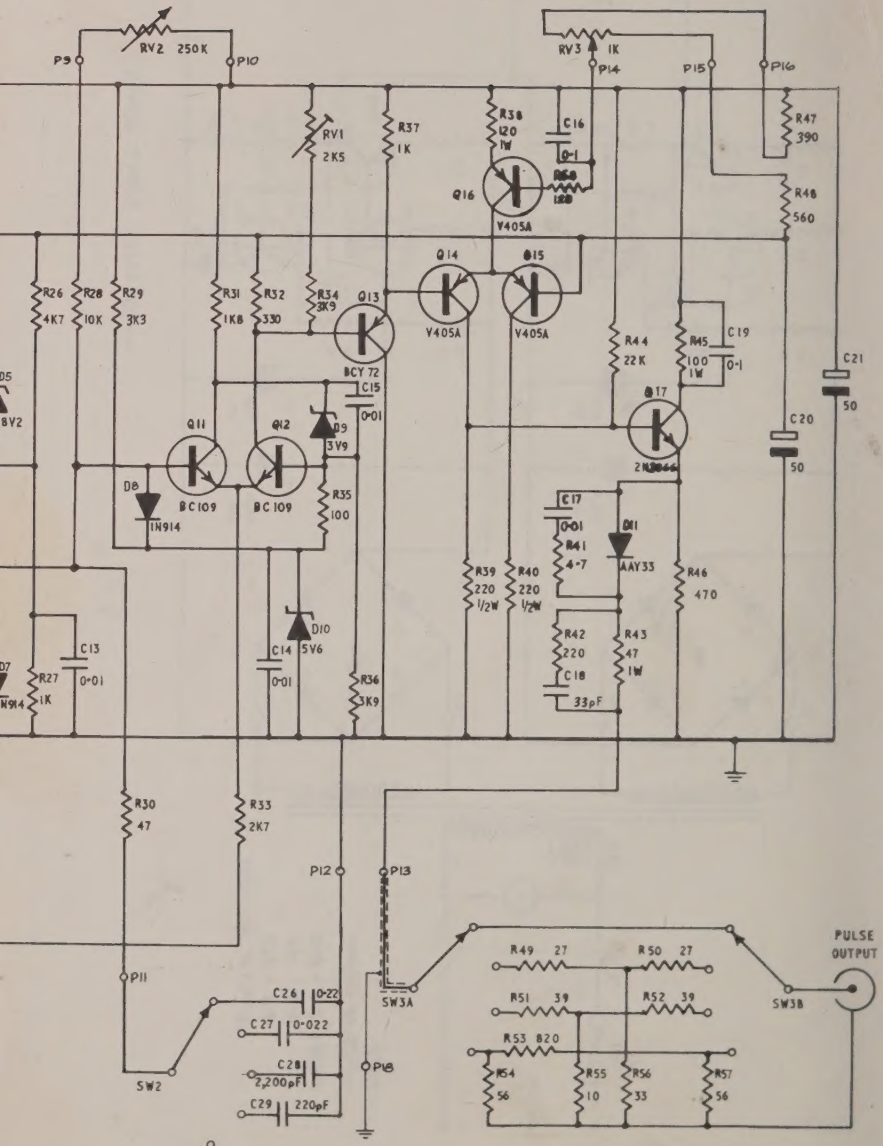

+24V
P1
C3
0·01
R22
390
½W
+12V
R2
470
R3
2K2
R7
100
R9
1K2
R10
1K5
R12
2K7
R16
1K2
D4
12V
R23
2K2
C9
0·01
C10
0·1
C12
0·01
Q3
BCY72
Q4
BCY72
Q10
BC108
Q5
BCY72
Q6
BCY72
D1
3V9
Q1
BC108
Q2
BC108
R8
2K7
C5
220 pF
C7
0·01
C8
47pF
Q8
BC108
Q9
BC108
C1
10pF
R1
1K2
R5
5K6
R6
15
R11
470
R13
390
R14
560
R17
560
R21
330
D6
0V
P2
C4
150pF
C2
0·01
D2
3V9
Q7
BC108
C11
47pF
C6
0·01
R19
470
D3
AAZ 13
R25
2K2
R4
3K3
R15
47
R18
6K8
R20
6K8
R24
1K8
-12V
P3
P4
P5
P6
P7
P8
C22
1·5
C23
0·15
C24
0·05
C25
1,500pF
SYNC
OUTPUT
RV4
250K
SW1
P17

PULSE GEN


P9
RV2 250K
P10
RV3 1K
P14
P15
P16
RV1 2K5
R37 1K
R38 120 1W
C16 0·1
Q16
R49 128
V405A
R47 390
R48 560
R26 4K7
R28 10K
R29 3K3
R31 1K8
R32 330
R34 3K9
Q13
BCY 72
Q14
Q15
V405A
V405A
R44 22K
R45 100 1W
C19 0·1
C21 50
C20 50
Q17
C15 0·01
D9 3V9
Q11
Q12
BC109
BC109
D8 1N914
R35 100
C17 0·01
D11 AAY33
R41 4·7
R39 220 1/2W
R40 220 1/2W
R46 470
R42 220
R43 47 1W
C18 33pF
D10 5V6
C14 0·01
C13 0·01
R27 1K
R36 3K9
R30 47
R33 2K7
P12
P13
P11
C26 0·22
C27 0·022
C28 2,200pF
C29 220pF
SW2
SW3A
R49 27
R50 27
R51 39
R52 39
R53 820
R54 56
R55 10
R56 33
R57 56
SW3B
PULSE OUTPUT
P18

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